

Several authors have described a gas detection set up with a VCSEL source where the wavelength of the VCSEL is scanned across the absorption line of the gas as represented in figure 2. This scanning is done with a given modulation frequency F . This modulation is achieved by imposing a small alternating current (100 μ A typically) of frequency F onto a constant current above the lasing threshold (some mA typically). For some measurement techniques, this "constant current" is slowly swept across the whole operation range of the VCSEL in order to detect subsequent absorption lines. With such a set up, a line filter is no longer needed which is an important cost reduction factor for low-cost products.

The present invention is based on a source formed by a wavelength modulated VCSEL and uses the fact that the modulation of the wavelength is directly connected to a modulation of the VCSEL output intensity. The intensity of the light having passed the gas volume and being incident on the detector therefore shows a first modulation related to the VCSEL intensity and a second modulation related to the gas absorption as the wavelength is scanned across the gas absorption line.

With a standard IR detector which delivers a signal proportional to the incident radiation, the signal treatment consists in measuring the detector signal by a lock-in technique on twice the modulation frequency ($2F$ -detection). By this, the DC signal component – which stems from the offset light detected throughout the modulation range – is suppressed. However, a reference beam has still to be used in order to obtain information about the overall light intensity of the initial light beam provided by the source for obtaining a precise value of the gas concentration. This reference beam is usually detected by a second specific detector. Thus, the generation and the detection of a reference beam complicate the device and increase its production cost.

US 6 356 350 B1 describes a method and an apparatus for demodulating a plurality of frequency components output from a photodetector in a wavelength modulation spectroscopy system and determining absorption line shapes from the demodulated data. The method allows information about the absorber line shape and line width, gas concentration measurement over a range of gas pressures temperatures and concentrations. For this, at least two even harmonics or a plurality of an harmonics of the wavelength modulation frequency F are necessary. In general, the prior art document teaches to use more even harmonic demodulated frequency components than other frequency components. The method disclosed in US 6 356 350 B1 is not appropriate for providing a gas detector device with low fabrication costs for large series which allows an efficient gas concentration measuring or presence of a gas.

An object of the present invention is to provide an efficient gas concentration measuring device or detector at low cost. In particular, the aim of the present invention is to solve the above mentioned problem relative to the reference beam.

5 This object is solved according the features of the independent method claim 1 and apparatus claim 3. Further advantageous features are claimed in the respective sub-claims.